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GEOLOGY OF CHINA.

Research in China. Vol. ii. Systematic Geology.

By Bailey Willis. Pp. v+133+v. (Washington: Carnegie Institution, 1907.)

It is difficult to be quite sure for what class of reader this work is intended. The main facts of interest have already appeared in the previous volume, but in this they are discussed from "the point of view of systematic continental history." In the present state of knowledge this might seem rather a hopeless undertaking, and the result does not dispel our misgivings; much of the explanatory matter is elementary, and much is merely speculative.

The reader's confidence in the author is somewhat rudely shaken at an early stage, as, for instance, at the close of chapter ii., where, on p. 34, it is first stated that "there is room to question what features existed in Central Asia during the Sinian period"; six lines further on, owing to the fact that the Sinian strata consist of limestone, this becomes "it is a fair inference that practically all Asia draining to the Cambro-Ordovician Sea was low and featureless." The next paragraph, however, begins, "The fact that Asia at the opening of the Paleozoic era was a featureless continent has important bearings." After this bold identification of fact with inference, it becomes necessary to inquire into the credentials of other so-called facts. One of the most interesting results recorded is the discovery of a glacial till in ancient rocks, said to be Cambrian. Convincing proof is given of the glacial character of this deposit; its age does not seem to be so clearly established. In the present volume we read,

"The tillite (*sic*) passes into a greenish shale . . . including characteristic pebbles. . . . This shale conglomerate . . . grades into the overlying limestone, the basal layer of a great thickness of Sinian."

But if we turn to vol. i., Blackwelder informs us that

"The Nan-t'ou formation [of which the till is the uppermost member] is limited above by an uneven surface, upon which lies a sheet of conglomerate. The matrix of the conglomerate is a greenish argillaceous limestone and the pebbles are like those in the underlying tillite. The two formations are therefore related by a basal conglomerate, which the till was well calculated to furnish. . . ."

This statement is sufficiently clear, and is accentuated by the two diagrams representing the succession of strata given on pp. 264 and 268, in each of which an undulating line is drawn between the conglomerate and the till. What, then, is in fact the relation of the till to the conglomerate? Do they pass into each other (Willis), or are they separated by an uneven line (Blackwelder)? But, again, is even the asserted age of the conglomerate a fact, or is it an inference? Turning once more to vol. i., we find on p. 269 that the till

"lies at the base of the Cambro-Ordovician limestone, from which we obtained Lower and Middle Cambrian fossils within less than 100 miles . . .

of Nan-t'ou. Hence it is highly probable that these glacial beds on the Yang-tzi are of early Cambrian age."

Though the fossils were found only a hundred miles away, we should still have been glad of additional evidence to show that the beds at Nan-t'ou were on one or other of the horizons they indicate.

It is of interest to note in passing that since the Sinian formation is equivalent to the Cambrian and Ordovician, it almost precisely corresponds to the Cambrian as defined by Sedgwick.

The summit of this formation is said to be on the horizon of the Trenton or Middle Ordovician; above this "it passes by transition into shales which are probably of Silurian or Devonian age." The suggested *passage by transition* of Middle Ordovician into either Silurian or Devonian shales leads to the suspicion that the author uses this term in some esoteric sense.

The treatment of the Angara and Gondwana beds is one of the most unsatisfactory chapters in the volume; both series are included under the head of Permo-Triassic strata, while so far as existing observations go, the Gondwana beds begin with the Lower or Middle Carboniferous,¹ while the most trustworthy evidence we possess points to a Jurassic age for the Angara. There is an inexactitude also in defining the limits of the Angara beds; they are not confined to the northern region indicated by the author, but extend to Afghanistan and through Turkestan, as Musketow has already pointed out.

Students of the geology of India will be surprised to learn that "no distinctly sedimentary pre-Cambrian rocks are known there," *i.e.* in the peninsula (p. 23), and those who have given attention to ripple marks will scarcely admit that they are to be taken offhand as evidence of "waves" in the common sense of this term (p. 38).

The structural trend-lines of Asia seem to be drawn for the most part after the maps of von Richthofen, Suess, Neumayr, and Futterer; it is pleasing to find that the generalisations of these great masters have been almost entirely confirmed by recent investigators. But we see no evidence for the postulated "Isle of Tibet." A region of which the geology is almost unknown naturally offers great temptations to the theorist.

There is some internal evidence of hasty writing, such as inaccuracies in translation conveying a rather different sense from that of the original; as an example we may cite the last sentence of the first paragraph (p. 69) from Suess:—

"The great height of the ranges is accompanied, however, by a relatively even more striking altitude of the valleys, a circumstance which diminishes the differences of level in the interior of the mountainous regions, but the observer is even thus below the limit of eternal snow."

This is rendered from the French, which runs:—

"L'altitude plus forte des chaînes a pour contrepartie une hauteur plus grande des fonds de vallées, ce qui atténue les différences de niveau à l'intérieur

¹ Neumayr and Waagen concluded in favour of an Upper Carboniferous age long ago, and Hayden has since shown that they must lie even lower.

de la région montagneuse, mais l'observateur ne s'en trouve que plus rapproché de la limite des neiges éternelles."

The French is a correct translation of the German.

The pith of this volume might have been summed up in a single chapter without losing any important contribution to science, and the space so saved might have been devoted to a much-needed bibliography of the subject. The author would not then have completely overlooked the work of the French explorers in Yün-nan. The artistic excellence of the numerous maps by which the volume is illustrated deserves unqualified praise.

FLOWERS AND WHAT THEY TEACH.

Types of Floral Mechanism. A Selection of Diagrams and Descriptions of Common Flowers. Arranged as an Introduction to the Study of Angiosperms. By Dr. A. H. Church, Part i., Types i.-xii. (January to April). Pp. vii+211; with 52 full-page plates (39 coloured) of floral structure, and 79 text-figures. (Oxford: Clarendon Press, 1908.) Price 21s. net.

THE title conveys a very imperfect idea of the nature of this work, which stands apart from all others that have been issued as introductions to the study of botany. The method of teaching botany by a careful investigation of selected types is, indeed, well known and much employed; but it has never been carried out, in English works at least, with any approach to the thoroughness of study of the types in themselves and in their relations to their environment and to their allies that we find here.

The author in a preface informs us that the admirable illustrations were originally prepared for class purposes, limited to a hundred types, of which twelve "Early Spring Types" are included in the present volume, and the arrangement and general scheme are designed to represent the working method applicable to the subject.

"No methods are indicated, nor have any been employed in making preparations which are beyond the reach of the 'elementary student'; and at the same time a general 'elementary' acquaintance with the subject on the part of the reader has been assumed. Since it is necessary to draw the line somewhere . . . and the present work is admittedly of only a general and elementary character, histological details are omitted."

The twelve types treated of are, successively, *Helleborus niger*, *Galanthus nivalis*, *Jasminum nudiflorum*, *Crocus vernus*, *Richardia africana*, *Daphne Mezereum*, *Viola odorata*, *Narcissus Pseudo-narcissus*, *Erica carnea*, *Ribes sanguineum*, *Cydonia japonica*, and *Vinca major*.

In the study of such a series, it is evident that there can be no close connection traced by an "elementary student" between so different types. Thus each becomes the subject of a separate monograph. That on *Viola odorata* may be taken as an example. A brief general notice of its appearance, habitats, tendency to vary, and production of cleistogamic flowers is accompanied by footnotes with references

to descriptions and figures by Dioscorides, Brunfels, Gerarde, and other early botanists, and to its names and cultivation in England. Then follow a detailed description of the inflorescence and flower, and a brief notice of the effects of cultivation on the flower. The floral diagram and phyllotaxis are fully discussed and illustrated, as are also the development of the floral members and the "special mechanism" of the flower for securing the reproduction of the species, including the relations with various bees. The cleistogamic flowers and the possible origin of this type of flower are then treated of.

The various floral "monstrosities" are enumerated, and are "referred to failures in the adjustment of certain features of the floral construction or mechanism." The development and structure of the capsules, their mode of opening, and the structure of the seeds conclude the discussion under *V. odorata*. Then follows a "Comparison of Allied Forms," under which six and a half pages are devoted to *Viola tricolor*, chiefly var. *arvensis*, and five pages to *V. altaica*, or "the garden pansy." For each of these a detailed comparison of the structure and mechanism of the several parts brings into view their resemblances and differences, and their relations with their environment. Although reference is made to the "very variable" *V. tricolor*, there is little stress laid on the extent of the tendency to vary, and the opinion is expressed, even with regard to the relations between *V. tricolor*, *V. lutea*, and allied alpine forms, that "no sharp line of demarcation either exists or need be drawn between 'specific forms' which only exist as useful conventions." While there is a risk of attaching too high a value to the many forms that have been distinguished and named by critical botanists in the genus *Viola*, as in a good many other genera, it may be questioned whether the author might not have usefully directed the attention of students to the nature and degrees of constancy of the forms so freely met with in the Linnean *V. tricolor*.

The study of the types selected is employed by Dr. Church as a basis for certain "Theoretical Conclusions" with regard to the origin and development of the genus *Viola*. The hypothesis is expressed that *V. odorata* is a "highly specialised representative of a shrubby, or even arboreal, plant-phyllum," with "panicles of regular flowers, which had already passed from an asymmetrical vegetative type of construction to a symmetrical pentamerous condition." From this a later evolution led to structural eccentricity of two phases, and to adaptations of the floral mechanism for visits of certain insects. These conclusions find support from a study of the genera associated in the family Violaceæ, *Viola* standing out "as the crowning genus of the entire group; the type, that is to say, in which the various modifications of the original construction are present in the greatest number, and combined to make a most efficient form of floral mechanism." The relations of the forms included under the family to types in other families are discussed, and the steps are summarised that led to the definition of the Violaceæ as a family.